

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of the claims in this application. Claim 15 has been canceled without prejudice or disclaimer.

Listing of Claims:

1. (Currently amended) A process for the hydroformylation of compounds which comprises, providing at least one compound with an ethylenically unsaturated double bond and reacting the at least one compound with carbon monoxide and hydrogen in at least one reaction zone in the presence of a catalytically active fluid which comprises a dissolved metal complex of a metal of transition group VIII of the Periodic Table of the Elements with at least one phosphoramidite compound as ligand, wherein the fluid is brought into contact with at least one base-base.

2. (Previously presented) A process according to claim 1, further comprising removing from the reaction zone a product mixture which is subjected to a fractionation to give a fraction consisting essentially of a hydroformylation product and a fraction comprising the catalytically active fluid in which the by-products of the hydroformylation which have boiling points higher than that of the hydroformylation product are present and the metal complex is dissolved, and recirculating the catalytically active fluid to the reaction zone.

3. (Previously presented) A process according to claim 1, wherein the at least one base is selected from bases soluble in the catalytically active fluid, bases immobilized on a solid phase or combinations thereof.

4. (Previously presented) A process according to claim 1, wherein the base comprises a basic nitrogen.

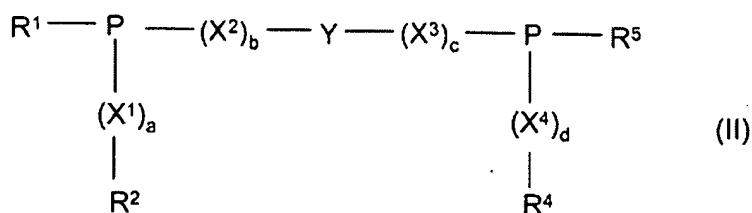
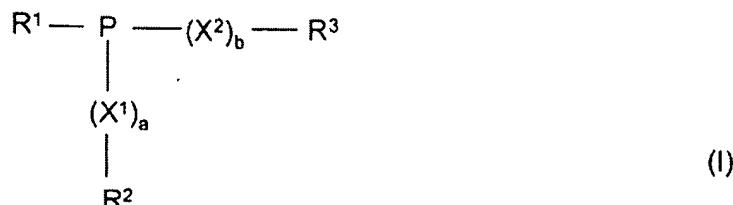
5. (Previously presented) A process according to claim 1, wherein the at least one base is soluble in the catalytic fluid and is present in a molar ratio of base to phosphoramidite compound of from 0.01:1 to 5:1, in the reaction zone.

6. (Previously presented) A process according to claim 1, wherein the at least one base includes a base soluble in the catalytic fluid and a base immobilized on a solid phase and the immobilized base is capable of at least partly liberating the soluble base from acid-base adducts obtained by reaction of the soluble base with an acid.

7. (Previously presented) A process according to claim 2, wherein the fractionation of the product mixture comprises a thermal separation step and at least one high-boiling soluble base remains in the catalytically active fluid after the fractionation.

8. (Previously presented) A process according to claim 2, wherein at least one base immobilized on a solid phase is used and the catalytically active fluid obtained after fractionation is brought into contact with the immobilized base before it is recirculated to the reaction zone.

9. (Currently amended) A process according to claim 1, wherein the phosphoramidite compound is selected from among compounds of the formulae I and II



where

R^1 and R^5 are each, independently of one another, pyrrole groups bound via the nitrogen atom to the phosphorus atom,

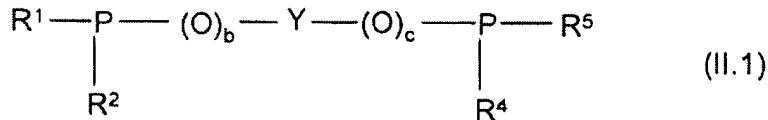
R^2 , R^3 and R^4 are each, independently of one another, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl, or R^1 together with R^2 and/or R^4 together with R^5 forms a divalent group containing at least one pyrrole group bound via the pyrrolic nitrogen atom to the phosphorus atom,

Y is a divalent bridged group having from 2 to 20 bridge atoms between the flanking bonds,

X^1 , X^2 , X^3 and X^4 are selected independently from among O, S, SiR^aR^b and NR^Y , where R^a , R^b and R^Y are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl, and

a , b , c and d are each, independently of one another, 0 or 1.

10. (Currently amended) A process according to ~~any of the preceding claims~~ claim 1, wherein the phosphoramidite compound is selected from among compounds of the formula II.1



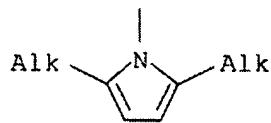
where R^1 and R^5 are each, independently of one another, pyrrole groups bound via the nitrogen atom to the phosphorus atom,

R^2 and R^4 are each, independently of one another, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl, or R^1 together with R^2 and/or R^4 together with R^5 forms a divalent group containing at least one pyrrole group bound via the pyrrolic nitrogen atom to the phosphorus atom,

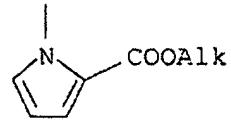
Y is a divalent bridged group having from 2 to 20 bridge atoms between the flanking bonds,

and b and c are each, independently of one another, 0 or 1.

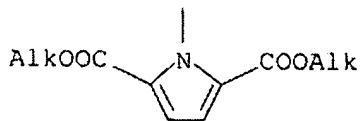
11. (Previously presented) A process according to claim 9, wherein R^1 , R^2 , R^4 and R^5 are selected independently from among groups of the formulae III.a to III.k



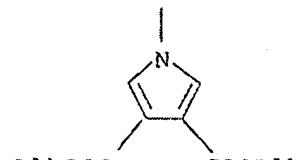
(III.a)



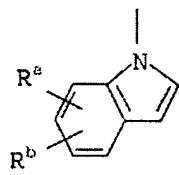
(III.b)



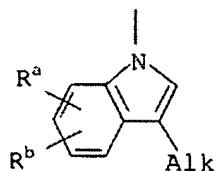
(III.c)



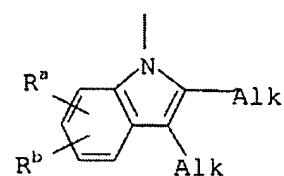
(III.d)



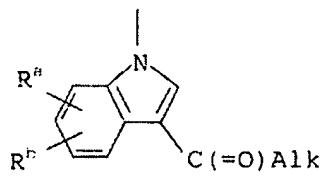
(III.e)



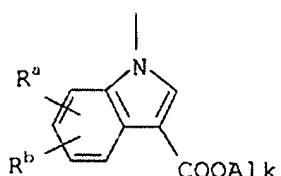
(III.f)



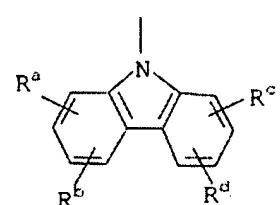
(III.g)



(III.h)



(III.i)



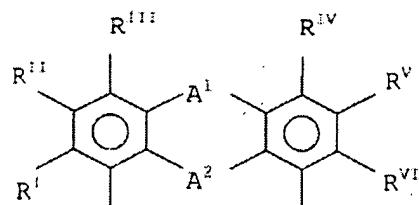
(III.k)

where

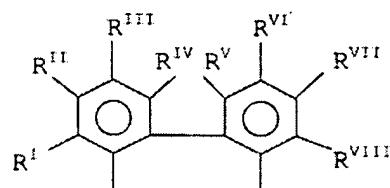
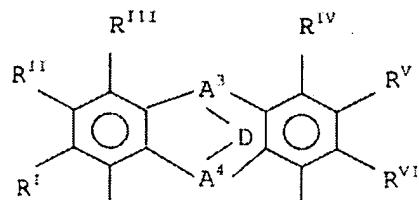
Alk is a C_1 - C_{12} -alkyl group and

R^a , R^b , R^c and R^d are each, independently of one another, hydrogen, C_1 - C_4 -alkyl, C_1 - C_4 -alkoxy, acyl, halogen, C_1 - C_4 -alkoxycarbonyl or carboxyl.

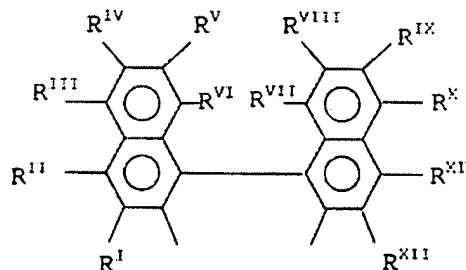
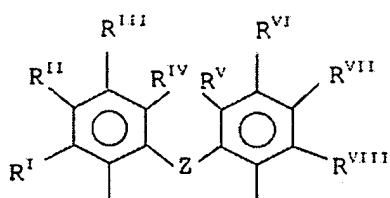
12. (Currently amended) A process according to claim 9, wherein the bridging group Y is selected from among groups of the formulae IV.a to IV.u

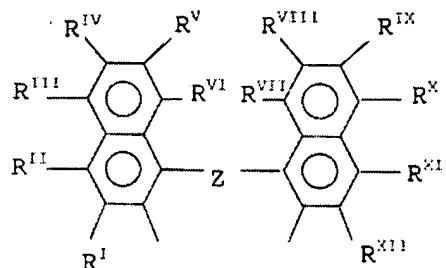


(IV.a)

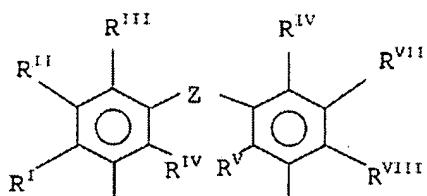


(IV.c)

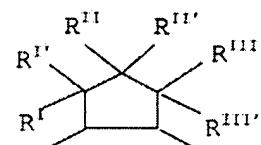




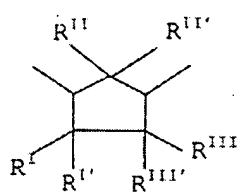
(IV.f)



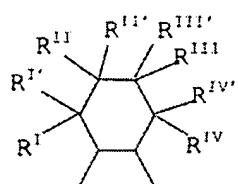
(IV.g)



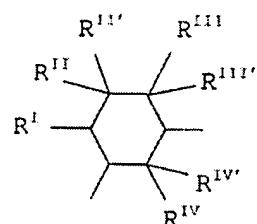
(IV.h)



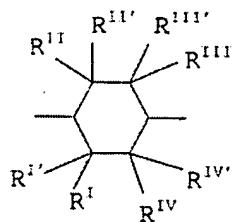
(IV.i)



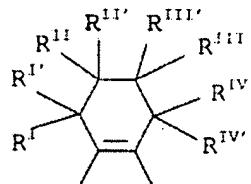
(IV.k)



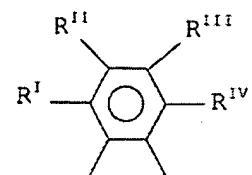
(IV.l)



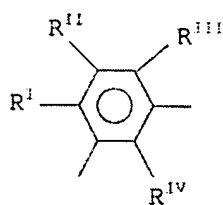
(IV.m)



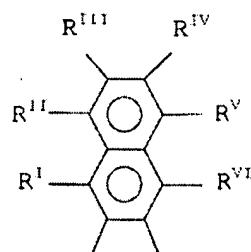
(IV.n)



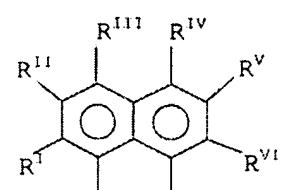
(IV.o)



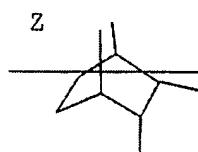
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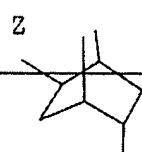
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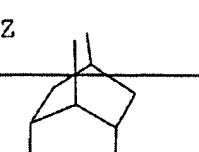
(IV.r)



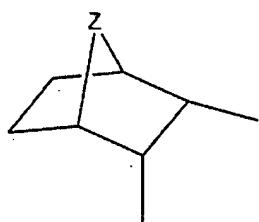
(IV.s)



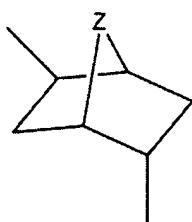
(IV.t)



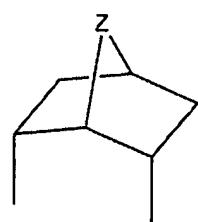
(IV.u)



(IV.s)



(IV.t)



(IV.u)

where

$R^1, R^I, R^{II}, R^{III}, R^{III'}, R^{IV}, R^{IV'}, R^V, R^{VI}, R^{VII}, R^{VIII}, R^{IX}, R^X, R^{XI}$ and R^{XII} are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, hydroxy, thiol, polyalkylene oxide, polyalkylenimine, alkoxy, halogen, SO_3H , sulfonate, NE^1E^2 , alkylene- NE^1E^2 , nitro, alkoxy carbonyl, carboxyl, acyl or cyano, where E^1 and E^2 are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl and aryl,

Z is O, S, NR^δ or $SiR^\delta R^e$, where

R^δ and R^e are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl,

or Z is a C_1 - C_4 -alkylene bridge which may have a double bond and/or bear an alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl substituent,

or Z is a C_2 - C_4 -alkylene bridge which is interrupted by O, S or NR^δ or $SiR^\delta R^e$,

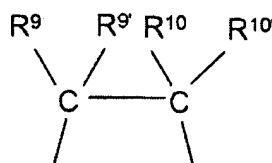
where, in the groups of the formulae IV.a and IV.b, two adjacent radicals R^I to R^{VI} together with the carbon atoms of the benzene ring to which they are bound may also form a fused ring system having 1, 2 or 3 further rings,

where, in the groups of the formulae IV.h to IV.n, two geminal radicals $R^I, R^I; R^{II}, R^{II'}$; $R^{III}, R^{III'}$ and/or $R^{IV}, R^{IV'}$ may also represent oxo or a ketal thereof,

A^1 and A^2 are each, independently of one another, $O, S, SiR^\delta R^Y, NR^n$ or $CR^i R^k$, where R^δ, R^Y, R^n, R^i and R^k are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl,

A^3 and A^4 are each, independently of one another, SiR, N or CR^i ,

D is a divalent bridging group of the formula



where

$R^9, R^{9'}, R^{10}$ and $R^{10'}$ are each, independently of one another, hydrogen, alkyl, cycloalkyl, aryl, halogen, trifluoromethyl, carboxyl, carboxylate or cyano,

where R^9 together with R^{10} can also represent the second bond of a double bond between the two carbon atoms to which R^9 and R^{10} are bound, and/or R^9 and R^{10} together with the carbon atoms to which they are bound may also form a 4- to 8-membered carbocycle or heterocycle which may additionally be fused with one, two or three cycloalkyl, heterocycloalkyl, aryl or hetaryl groups, where the heterocycle and, if present, the fused-on groups may each bear, independently of one another, one, two, three or four substituents selected from among alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, $COOR^f$, $COOM^+$, SO_3R^f , SO_3M^+ , NE^4E^5 , alkylene- NE^4E^5 , $NE^4E^5E^6X^+$, alkylene- $NE^4E^5E^6X^+$, OR^f , SR^f , $(CHR^eCH_2O)_yR^f$, $(CH_2N(E^4))_yR^f$, $(CH_2CH_2N(E^4))_yR^f$, halogen, trifluoromethyl, nitro, acyl and cyano, where

R^f , E^4 , E^5 and E^6 are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl and aryl,

R^e is hydrogen, methyl or ethyl,

M^+ is a cation,

is an anion and

y is an integer from 1 to 240.

13. (Previously presented) A method of stabilizing a catalytically active fluid comprising a dissolved metal complex of a metal of transition group VIII of the Periodic Table of the Elements with at least one phosphoramidite compound as ligand in the hydroformylation of ethylenically unsaturated compounds, which comprises bringing the fluid into contact with at least one base.

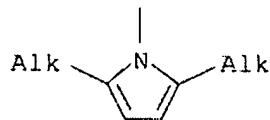
14. (Previously presented) A method according to claim 13, wherein base is soluble in the catalytically active fluid and/or the fluid is brought into contact with a base immobilized on a solid phase.

15. (Canceled)

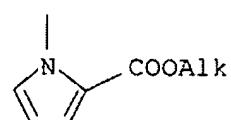
16. (Previously presented) A process according to claim 2 further comprising removing at least part of the by-products from the catalytically active fluid prior to recirculating the fluid.

17. (Previously presented) A process according to claim 5, wherein the molar ratio is from 0.1:1 to 1.5:1.

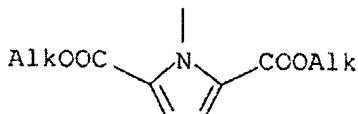
18. (Previously presented) A process according to claim 10, wherein R¹, R², R⁴ and R⁵ are selected independently from among groups of the formulae III.a to III.k



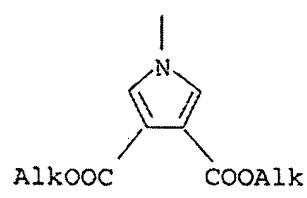
(III.a)



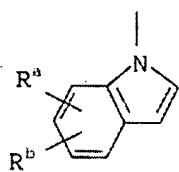
(III.b)



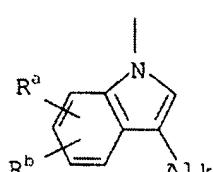
(III.c)



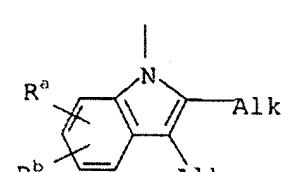
(III.d)



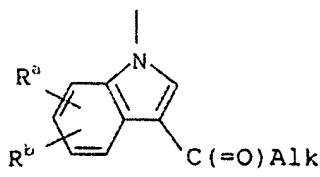
(III.e)



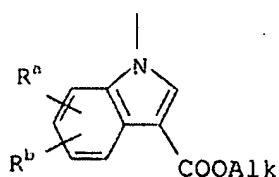
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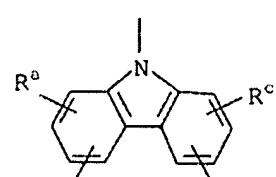
(III.g)



(III.h)



(III.i)



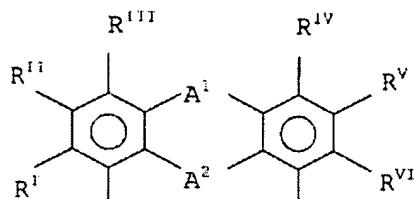
(III.k)

where

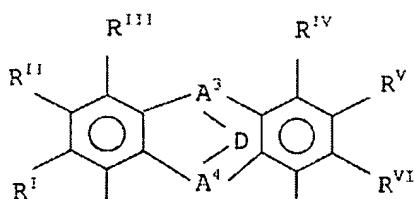
Alk is a C₁-C₁₂-alkyl group and

R^a, R^b, R^c and R^d are each, independently of one another, hydrogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, acyl, halogen, C₁-C₄-alkoxycarbonyl or carboxyl.

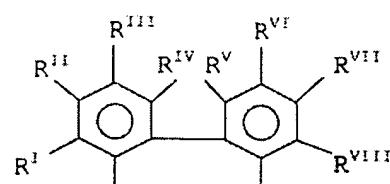
19. (Currently amended) A process according to claim 10, wherein the bridging group Y is selected from among groups of the formulae IV.a to IV.u



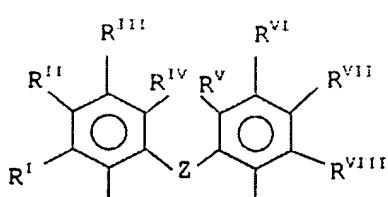
(IV.a)



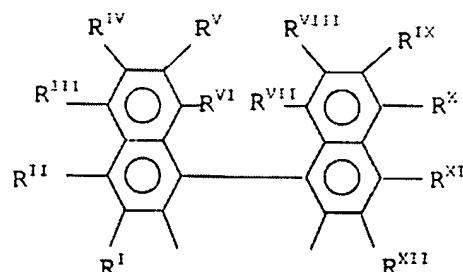
(IV.b)



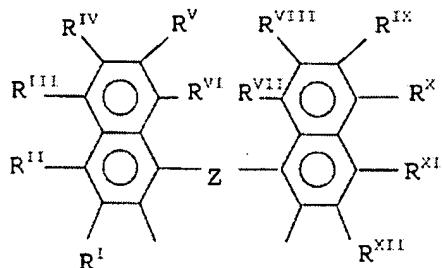
(IV.c)



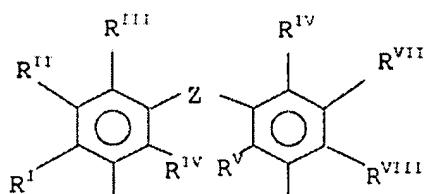
(IV.d)



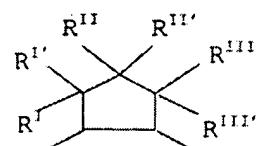
(IV.e)



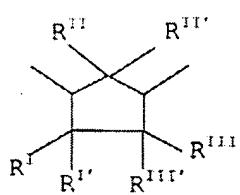
(IV.f)



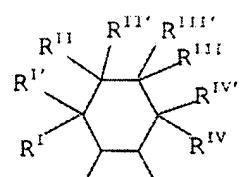
(IV.g)



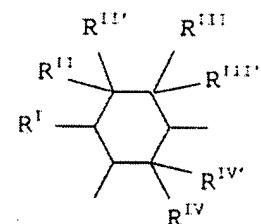
(IV.h)



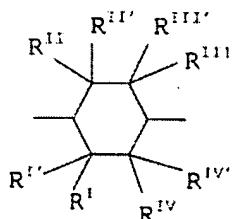
(IV.i)



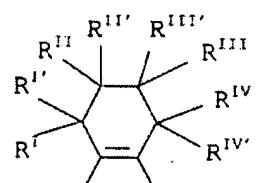
(IV.k)



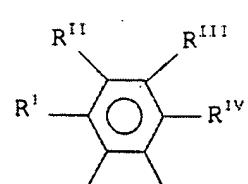
(IV.l)



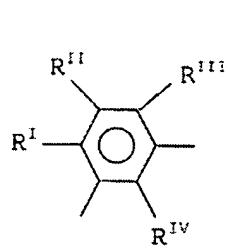
(IV.m)



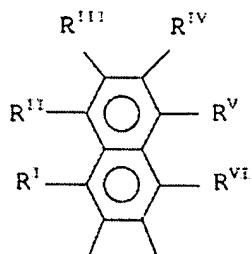
(IV.n)



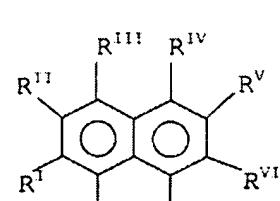
(IV.o)



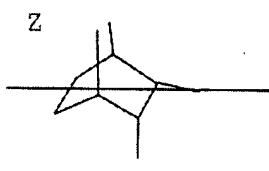
(IV.p)



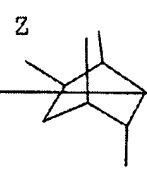
(IV.q)



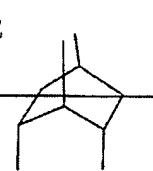
(IV.r)



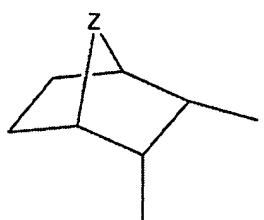
(IV.s)



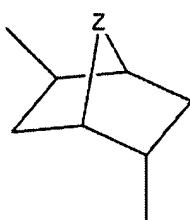
(IV.t)



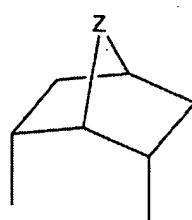
(IV.u)



(IV.s)



(IV.t)



(IV.u)

where

R^I, R^{II}, R^{III}, R^{IV}, R^V, R^{VI}, R^{VII}, R^{VIII}, R^{IX}, R^X, R^{XI} and R^{XII} are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, hydroxy, thiol, polyalkylene oxide, polyalkylenimine, alkoxy, halogen, SO₃H, sulfonate, NE¹E², alkylene-NE¹E², nitro, alkoxycarbonyl, carboxyl, acyl or cyano, where E¹ and E² are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl and aryl,

Z is O, S, NR^δ or SiR^δR^ε, where

R^δ and R^ε are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl,

or Z is a C₁-C₄-alkylene bridge which may have a double bond and/or bear an alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl substituent,

or Z is a C₂-C₄-alkylene bridge which is interrupted by O, S or NR^δ or SiR^δR^ε,

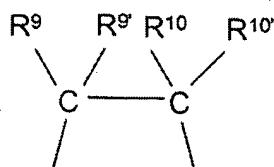
where, in the groups of the formulae IV.a and IV.b, two adjacent radicals R^I to R^{VI} together with the carbon atoms of the benzene ring to which they are bound may also form a fused ring system having 1, 2 or 3 further rings,

where, in the groups of the formulae IV.h to IV.n, two geminal radicals R^I, R^{I'}; R^{II}, R^{II'}; R^{III}, R^{III'} and/or R^{IV}, R^{IV'} may also represent oxo or a ketal thereof,

A¹ and A² are each, independently of one another, O, S, SiR^φR^γ, NR^η or CR^IR^κ, where R^φ, R^γ, R^I, R^κ are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl,

A³ and A⁴ are each, independently of one another, SiR, N or CR^I,

D is a divalent bridging group of the formula



where

R⁹, R^{9'}, R¹⁰ and R^{10'} are each, independently of one another, hydrogen, alkyl, cycloalkyl, aryl, halogen, trifluoromethyl, carboxyl, carboxylate or cyano,

where R^{9'} together with R^{10'} can also represent the second bond of a double bond between the two carbon atoms to which R^{9'} and R^{10'} are bound, and/or R⁹ and R¹⁰ together with the carbon atoms to which they are bound may also form a 4- to 8-membered carbocycle or heterocycle which may additionally be fused with one, two or three cycloalkyl, heterocycloalkyl, aryl or hetaryl groups, where the heterocycle and, if present, the fused-on groups may each bear, independently of one another, one, two, three or four substituents selected from among alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, COOR^f, COO⁺M⁺, SO₃R^f, SO₃⁺M⁺, NE⁴E⁵, alkylene-NE⁴E⁵, NE⁴E⁵E⁶⁺X⁻, alkylene-NE⁴E⁵E⁶⁺X⁻, OR^f, SR^f, (CHR^eCH₂O)_yR^f, (CH₂N(E⁴))_yR^f, (CH₂CH₂N(E⁴))_yR^f, halogen, trifluoromethyl, nitro, acyl and cyano, where

R^f , E^4 , E^5 and E^6 are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl and aryl,

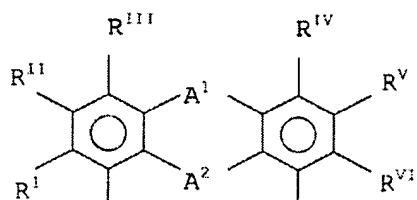
R^c is hydrogen, methyl or ethyl,

M^+ is a cation,

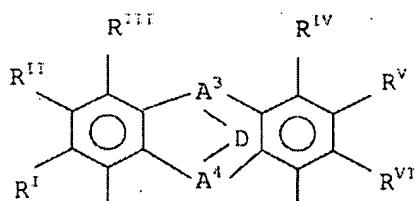
is an anion and

y is an integer from 1 to 240.

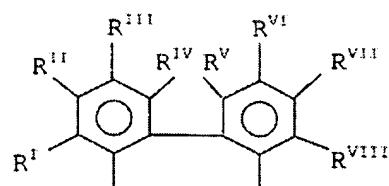
20. (Currently amended) A process according to claim 11, wherein the bridging group Y is selected from among groups of the formulae IV.a to IV.u



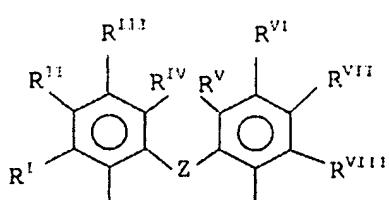
(IV.a)



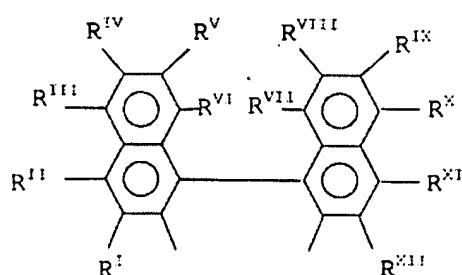
(IV.b)



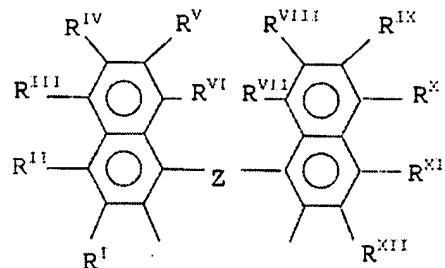
(IV.c)



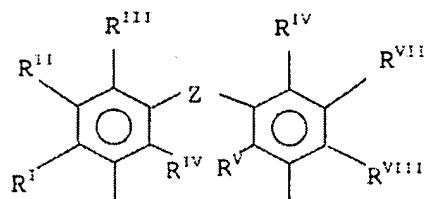
(IV.d)



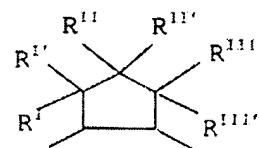
(IV.e)



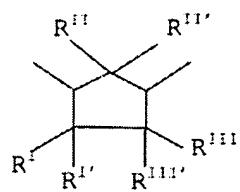
(IV.f)



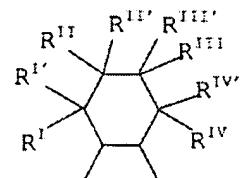
(IV.g)



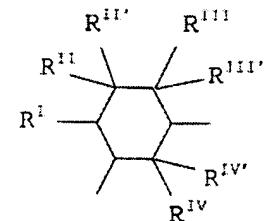
(IV.h)



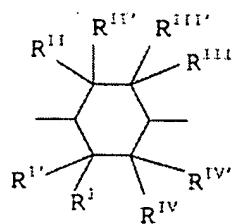
(IV.i)



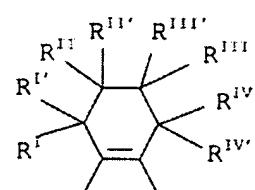
(IV.k)



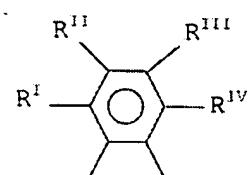
(IV.l)



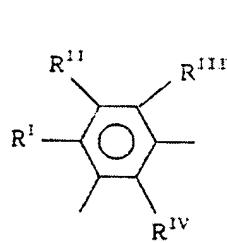
(IV.m)



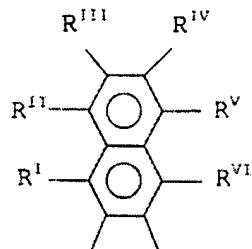
(IV.n)



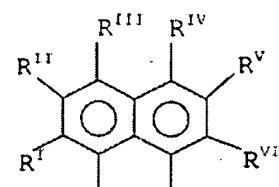
(IV.o)



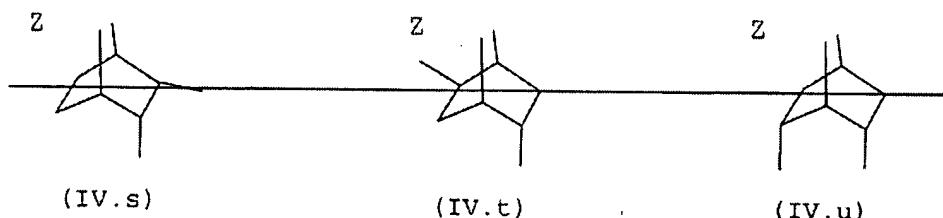
(IV.p)



(IV.q)



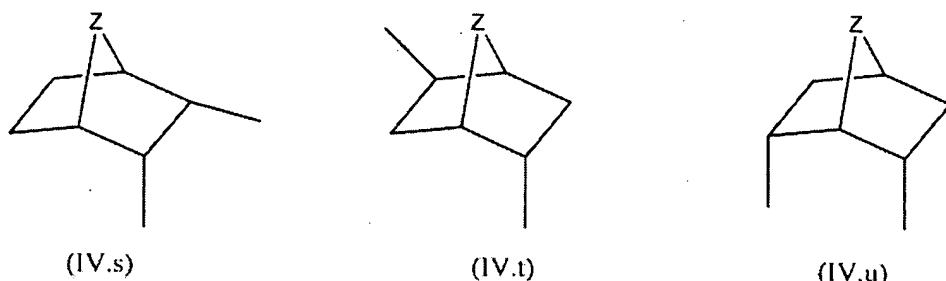
(IV.r)



(IV.s)

(IV.t)

(IV.u)



(IV.s)

(IV.t)

(IV.u)

where

R¹, R¹¹, R¹¹¹, R^{IV}, R¹¹¹¹, R¹¹¹¹¹, R¹¹¹¹¹¹, R¹¹¹¹¹¹¹, R¹¹¹¹¹¹¹¹, R¹¹¹¹¹¹¹¹¹, R¹¹¹¹¹¹¹¹¹¹, R¹¹¹¹¹¹¹¹¹¹¹, R¹¹¹¹¹¹¹¹¹¹¹¹, R¹¹¹¹¹¹¹¹¹¹¹¹¹, R¹¹¹¹¹¹¹¹¹¹¹¹¹¹ and R¹¹¹¹¹¹¹¹¹¹¹¹¹¹¹ are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, hydroxy, thiol, polyalkylene oxide, polyalkylenimine, alkoxy, halogen, SO₃H, sulfonate, NE¹E², alkylene-NE¹E², nitro, alkoxy carbonyl, carboxyl, acyl or cyano, where E¹ and E² are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl and aryl,

Z is O, S, NR^δ or SiR^δR^ε, where

R^δ and R^ε are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl,

or Z is a C₁-C₄-alkylene bridge which may have a double bond and/or bear an alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl substituent,

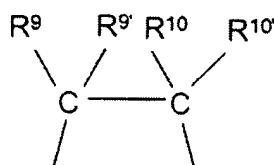
or Z is a C₂-C₄-alkylene bridge which is interrupted by O, S or NR^δ or SiR^δR^ε, where, in the groups of the formulae IV.a and IV.b, two adjacent radicals R¹ to R^{VI} together with the carbon atoms of the benzene ring to which they are bound may also form a fused ring system having 1, 2 or 3 further rings,

where, in the groups of the formulae IV.h to IV.n, two geminal radicals R¹, R^{II}; R^{II}, R^{III}; R^{III}, R^{IV} and/or R^{IV}, R^{IV} may also represent oxo or a ketal thereof,

A¹ and A² are each, independently of one another, O, S, SiR^φR^γ, NR^η or CR^ιR^κ, where R^φ, R^γ, R^η, R^ι and R^κ are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl or hetaryl,

A³ and A⁴ are each, independently of one another, SiR, N or CR^ι,

D is a divalent bridging group of the formula



where

R⁹, R^{9'}, R¹⁰ and R^{10'} are each, independently of one another, hydrogen, alkyl, cycloalkyl, aryl, halogen, trifluoromethyl, carboxyl, carboxylate or cyano,

where R^{9'} together with R^{10'} can also represent the second bond of a double bond between the two carbon atoms to which R^{9'} and R^{10'} are bound, and/or R⁹ and R¹⁰ together with the carbon atoms to which they are bound may also form a 4- to 8-membered carbocycle or heterocycle which may additionally be fused with one, two or three cycloalkyl, heterocycloalkyl, aryl or hetaryl groups, where the heterocycle and, if present, the fused-on groups may each bear, independently of one another, one, two, three or four substituents selected from among alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, COOR^f, COOM⁺, SO₃R^f, SO₃M⁺, NE⁴E⁵, alkylene-NE⁴E⁵, NE⁴E⁵E⁶⁺X⁻, alkylene-NE⁴E⁵E⁶⁺X⁻, OR^f, SR^f, (CHR^cCH₂O)_yR^f, (CH₂N(E⁴))_yR^f, (CH₂CH₂N(E⁴))_yR^f, halogen, trifluoromethyl, nitro, acyl and cyano, where

R^f , E^4 , E^5 and E^6 are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl and aryl,

R^e is hydrogen, methyl or ethyl,

M^+ is a cation,

is an anion and

y is an integer from 1 to 240.

21. (New) The process according to claim 1, wherein the at least one base is selected from trialkylamines, dialkyarylamin es, alkyldiarylamines, and triarylamines; or a mixture thereof, and

wherein the at least one base is immobilized on a solid phase.

22. (New) The process according to claim 1, wherein the at least one base is immobilized on a solid phase.